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ABSTRACT

This curriculum guide is designed to upgrade the secondary electrical trades program in Mississippi by broadening its scope to incorporate basic electronic principles. Covered in the individual chapters of the guide are the following courses: basic electricity (occupational information, basic physics, circuit fundamentals, resistance and Ohm's law, direct current sources and circuit analysis, magnetism, measuring devices, alternating current wave forms, inductance, transformers, capacitance, resistive-inductive-capacitive circuits, and resonance); basic wiring (occupational information, tools, blueprints and specifications, device identification, procedures for using devices, residential circuits, and existing dwellings); advanced wiring (industrial wiring tools, industrial blueprints and schematics, industrial wiring devices, industrial and commercial circuits, and motors and generators); and an introduction to controls and electronics (electro-mechanical control systems, solid state devices and power supplies, solid state controls, digital electronics, and microprocessors). Each course outline contains an objective, a list of class and shop time allocations, an outline of instruction, and suggested shop activities. An equipment list concludes the guide.
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A CURRICULUM GUIDE
FOR
ELECTRICITY/ELECTRONICS

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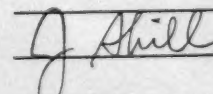
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FOREWORD

This curriculum guide was designed to upgrade the secondary electrical trades programs in Mississippi. The "High Technology Revolution" has forced all trade area programs to examine and evaluate their curriculum. This guide broadens the scope of the secondary electrical trades programs to incorporate basic electronic principles. Plans are underway to assure that instructors are offered opportunities to acquire this basic understanding of electronics principles. Instructors are encouraged to seek electronics training from their district junior colleges.

The courses outlined within this guide are not totally sequential in nature. The Basic Electricity course should be covered before Introduction to Controls and Electronics or Basic Wiring. However, the sequence of other courses is left to the discretion of the local instructor. For example, Basic Electricity and Introduction to Controls and Electronics could be offered before Basic and Advanced Wiring.

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BASIC ELECTRICITY

One Semester

Basic Electricity. This course is designed to familiarize the student with basic electrical fundamentals in alternating and direct currents which are prerequisite to subsequent courses. Hands on exercises provide theory reinforcement and familiarization with test equipment. Students entering this course should have an understanding of math and basic algebra.

MAJOR DIVISIONS	Class Hours	Shop Hours
I. OCCUPATIONAL INTRODUCTION	15	3
II. BASIC PHYSICS	9	4
III. CIRCUIT FUNDAMENTALS	7	14
IV. RESISTANCE-OHM'S LAW	25	15
V. DIRECT CURRENT SOURCES	4	2
VI. DIRECT CURRENT CIRCUIT ANALYSIS	6	6
VII. FUNDAMENTALS OF MAGNETISM	3	1
VIII. MEASURING DEVICES: PRINCIPLES, USE AND CARE	21	15
IX. AC WAVEFORMS	14	5
X. INDUCTANCE	14	5
XI. TRANSFORMERS	14	8
XII. CAPACITANCE	14	5
XIII. RLC CIRCUITS	14	5
XIV. RESONANCE	14	8
	Total Class Hours	Total Shop Hours
	174	96

Total Suggested Clock Hours 270

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
I. OCCUPATIONAL INTRODUCTION A. Safety 1. Personal safety 2. First aid 3. Rules and regulations B. Shop Safety 1. Electrical safety 2. Rules and regulations	15	A. Shop Demonstrations (Safety and First Aid) B. Shop Hazards	3
II. BASIC PHYSICS A. Atomic Structure 1. Definitions 2. Electron theory B. Conductors, Insulators, and Semiconductors C. Static Electricity 1. Attraction and repulsion of charges 2. Electrostatic field D. Scientific Notation 1. Mathematical operations involving exponents	9	A. Problem Solving B. Associated Math	4

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
III. CIRCUIT FUNDAMENTALS A. The Volt B. The Ampere C. The Ohm D. The Coulomb E. The Watt	7	A. Use and Application of the 1. Voltmeter 2. Ammeter 3. Ohmmeter B. Safety	14
IV. RESISTANCE - OHM'S LAW A. Electrical Resistance 1. Color code and its use 2. Types of resistors 3. Uses of resistors B. Ohm's Law 1. Current 2. Voltage 3. Resistance 4. Conductance C. Simple Resistive Circuits 1. Series circuits 2. Parallel circuits 3. Series-parallel circuits 4. Potentiometers and rheostats	25	A. Problem Solving Using the Color Code and Ohmmeter B. Exercises Involving the Use of Voltmeters and Ammeters, as Applied to Resistive Circuits C. Applications of Ohm's Law to Series and Parallel Circuits D. Applications of Power Formulas to Series and Parallel Circuits	15

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
D. Power Dissipation - Formulas - Applications to resistive circuits			
V. DIRECT CURRENT SOURCES - Batteries - Primary cells - Secondary cells - Generators and Other DC Sources - Current Sources	4	- Measure Specific Gravity of Charged and Uncharged Cells - Test Cells Under Load - Chemistry of Batteries	2
VI. DIRECT CURRENT CIRCUIT ANALYSIS - Kirchhoff's Law - Voltage law - Current law - Maximum Power Transfer - Voltage Dividers - Current Dividers	6	- Problem Solving - Investigate Principles of One or More Networks - Using Laboratory Equipment, Verify Theorems - Exercises Involving the Use of Voltage and/or Current Dividers	6
VII. FUNDAMENTALS OF MAGNETISM - Permanent Magnets - Domain Theory	3	- Problem Solving - Demonstrations of	1

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
2. Units B. Electromagnets 1. Construction 2. Hysteresis C. Magnetic Fields		Effects of Magnets and Simple Electromagnets	
VIII. MEASURING DEVICES: PRINCIPLES, CARE, AND USE A. Meter Movements 1. D'Arsonval 2. Iron vane B. Ammeters 1. Shunts 2. Loading effect C. Voltmeters 1. Multipliers 2. Sensitivity 3. Loading effect D. Ohmmeter 1. Series 2. Shunt 3. Series - shunt E. Multimeters 1. Digital multimeters	21	A. Observe and Study Working Models of Various Meter Movements B. Calculations and Applications Involving the Use of Ammeter Shunts and Voltmeter Multipliers	15

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
2. Transistorized voltmeters F. Other Devices 1. Galvanometer 2. Wheatstone bridge 3. Megger 4. Wattmeter G. Oscilloscope 1. Triggered oscilloscope 2. Nontriggered oscilloscope		C. Applications of Single and Dual Trace Scopes and Audio Frequency Generators	
IX. AC WAVEFORMS A. The Sine Wave 1. Generation 2. Induced electromotive force (EMF) B. Sine Wave Characteristics 1. Instantaneous value 2. Peak value 3. Peak-to-peak value 4. Root-mean-square (RMS) 5. Average value 6. Frequency	15	A. Measurement of Frequency, Period, and Amplitude Utilizing Time Base Oscilloscope B. Problem Solving	5

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
7. Period			
8. Phase relationships			
X. INDUCTANCE	14		5
A. Characteristics of Inductance 1. Definition 2. Lenz's Law 3. Measurement of Inductance 4. Inductive reactance 5. Impedance 6. Voltage-current relationships 7. Types of Inductors B. Series and Parallel Inductors 1. Mutual inductance 2. Fields aiding 3. Fields opposing		A. Determine the Value of Several Inductors (Using Z Meter) B. Identify Types of Inductors	
XI. TRANSFORMERS	14		8
A. Characteristics of Transformers 1. Turns ratio 2. Transformer losses and efficiency 3. Reflected impedance		A. Problem Solving B. Familiarize Students with Transformer Color Code; Investigate Voltage and Current Relationships on Primary and Secondary of Step-Up	

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
4. Impedance matching B. Types of Transformers 1. Audio transformers 2. Radio-frequency (RF) transformers 3. Power transformers 4. Autotransformers 5. Voltage step-up and step-down 6. Current step-up and step-down 7. Isolation transformers 8. Impedance matching		and Step-Down Transformers (Include Observation of Auto-transformer Action) C. Problem Solving Using Ratio and Proportions	
XII. CAPACITANCE A. Characteristics of Capacitance 1. Definition 2. Coulomb's Law 3. Measurement of capacitance 4. Capacitive reactance 5. Impedance 6. Voltage-current relationships 7. Series and parallel combinations	14	A. Determine Value and Leakage of Several Capacitors (Using Capacitor Analyzer or Z Meter) B. Demonstration of Capacitor Types	5

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
XIII. RESISTIVE-INDUCTIVE-CAPACITIVE (RLC) CIRCUITS A. Time Constants 1. Resistive-inductive (RL) time constants 2. Resistive-capacitive (RC) time constants 3. Time constant equations B. Series and Parallel RLC Circuits 1. Series RLC circuits 2. Parallel RLC circuits 3. Power in alternating current (AC) circuits 4. Power factor 5. Phase angle	14	A. Problem Solving B. Use Universal Time Constant Curve to Observe RL and RC Time Constants C. Set up RLC Circuits and Measure Voltage, Current, and Phase Relationships - Use These to Verify Calculations of Impedance, Phase Angle, and Power Factor	5
XIV. RESONANCE A. Series and Parallel Resonance 1. Resonant circuits 2. Resonance curves 3. Series resonance 4. Parallel resonance	14	A. Problem Solving B. Develop Simple Series and Parallel Resonant Circuits - Measure Voltage and Current Relationships to Verify Impedance and Q-Plot Resonance Curves	8

BASIC ELECTRICITY REFERENCES:

- I. Buban, Peter and Schmitt, Marshall L. Understanding Electricity and Electronics. 4th ed. New York: Gregg/McGraw-Hill, 1982.
- II. Gerrish, Howard H. and Dugger, William E. Electricity and Electronics. Illinois: Goodheart-Wilkox Company, Inc., 1980.
- III. Grob, Bernard. Basic Electricity. 4th ed. New York: Gregg/McGraw-Hill.
- IV. Miller, Rex and Culpepper, Fred W. Energy: Electricity/ Electronics. Ohio: South-Western Publishing Co., 1982.
- V. Orla Loper, Arthur Ahr and Clendenning, Lee. Introduction to Electricity and Electronics. New York: Delmar Publishers, 1979.

BASIC WIRING

One Semester

Basic Wiring.--This course is designed to familiarize the student with residential (single family dwelling) wiring, devices, methods and circuits. Hands on practice reinforce the lectures and demonstrations. Upon completion of this course the student will have basic entry level skills for residential wiring. Basic Electricity is the prerequisite for this course.

MAJOR DIVISIONS	Class Hours	Shop Hours
I. OCCUPATIONAL INTRODUCTION	15	0
II. TOOLS	15	5
III. BLUEPRINTS AND SPECIFICATIONS	15	20
IV. DEVICE IDENTIFICATION	5	5
V. PROCEDURES FOR USING DEVICES	55	61
VI. RESIDENTIAL CIRCUITS	15	50
VII. EXISTING DWELLING	Total Class Hours	Total Shop Hours
	3 123	6 147
Total Suggested Clock Hours		270

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
I. OCCUPATIONAL INTRODUCTION A. Safety B. Job Opportunities 1. Type working environment 2. Pay scale 3. Availability 4. Apprenticeship 5. Labor unions	15		0
II. TOOLS A. Hand Tools B. Special Tools C. Tool Safety 1. Proper use 2. Care and maintenance	15	A. Shop Demonstrations	5
III. BLUEPRINTS AND SPECIFICATIONS A. Use of the Rule B. Scale C. Applications of the Rule D. Introduction to Electrical Codes E. Electrical Symbols F. Electrical Lay-Out	15	A. Shop Practice Using Measuring Devices B. Shop Practice Measuring C. Shop Practice Laying Out Electrical Prints	20

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
3. Maximum number of conductors 4. Strain relief C. Panels 1. Types and sizes 2. Mounting 3. Ampacity 4. Number of circuits 5. Overcurrent devices 6. (GFCI) ground fault circuit interrupt D. Switches 1. Single pole 2. 3-way 3. 4-way 4. Others E. Receptacles 1. Single 2. Multipurpose a. Duplex b. Split circuit 3. Special Purpose F. Fixtures 1. Surface 2. Recess 3. Others	17	C. Practice Mounting Panels D. Practice Mounting Switches E. Practice Mounting Receptacles F. Practice Mounting Fixtures	

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
G. Conduit 1. Cutting 2. Threading 3. Bending 4. Connectors 5. Strapping 6. Wire-fill calculations		G. Practice Preparing Conduit for Various Jobs	
H. Connectors 1. Types 2. Sizes 3. Uses		H. Practice Using Connectors	
I. Special Purpose Devices 1. Types 2. Sizes 3. Local demand 4. Uses 5. Low voltage		I. Practice Mounting Special Purpose Devices	
VI. RESIDENTIAL CIRCUITS A. Rough In 1. Layout a. Locate on blue-print	15	A. Shop Practice Layout and Marking	50

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
b. Mark location (1) Switch boxes (2) Receptacle outlets (3) Lighting outlets (4) Service equipment (5) Special purpose devices 2. Installation a. Mounting b. Drilling c. Pulling and routing d. Inspection			
B. Trim Out 1. Install a. Receptacles b. Switches c. Fixtures d. Covers e. Breakers f. Disconnects g. Special purpose outlets		B. Shop Practice Installing Devices C. Complete Inspection of Work D. Install Devices in Shop	

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
2. Test 3. Final inspection		E. Test Hookup F. Complete Final Inspection	
VII. EXISTING DWELLING A. Requirements for Remodeling 1. Cable installation through existing walls 2. Box locations 3. Updating load centers B. Test Circuits C. Final Inspection	3	A. Electrically Remodel an Existing Dwelling B. Test Circuits C. Complete Final Inspection	6

BASIC WIRING REFERENCES:

- I. Clidero, Robert K. and Sharpe, Kenneth H. Construction Wiring. New York: Delmar Publishers, 1982.
- II. Foley, Joseph H. Electrical Wiring Fundamentals. New York: Gregg/McGraw-Hill, 1981.
- III. Herrick, Clyde N. Electrical Wiring: Principles and Practices. New York: Prentice-Hall, Inc., 1975.
- IV. Hawkins, Harry M. Residential Wiring: Concepts and Practices. New York: Delmar Publishers, 1983.
- V. Johnson, Robert C. Electrical Wiring: Design and Construction. New York: Prentice-Hall, Inc., 1971.

ADVANCED WIRING

One Semester

Advanced Wiring.--This course is designed to expand the students knowledge of wiring to include commercial and industrial devices, methods and circuits. Hands on practice reinforce the lectures and demonstrations. Upon completion of this course the student will have basic entry level skills for commercial and industrial wiring. Basic Wiring is the prerequisite for this course.

MAJOR DIVISIONS	CLASS HOURS	SHOP HOURS
I. REVIEW OF BASIC WIRING	15	15
II. OCCUPATIONAL INTRODUCTION	15	
III. INDUSTRIAL WIRING TOOLS	3	6
IV. INDUSTRIAL BLUEPRINTS AND/OR SCHEMATICS	20	20
V. INDUSTRIAL WIRING DEVICES	52	33
VI. INTRODUCTION TO INDUSTRIAL AND COMMERCIAL CIRCUITS	45	15
VII. MOTORS AND GENERATORS	Total 21 Class Hours 171	Total 10 Shop Hours 99
Total Suggested Clock Hours <u>270</u>		

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
I. REVIEW OF BASIC WIRING	15		15
A. Basic Electricity		A. Demonstrate Proper Use of Tools and Shop Equipment	
1. Safety			
2. Basic physics		B. Evaluation of Proper Use of Tools and Equipment	
3. Circuit fundamentals			
4. Resistance-OHM'S Law			
5. Direct current sources			
6. Direct current circuit analysis			
7. Fundamentals of magnetism			
8. Measuring devices			
9. AC waveforms			
10. Inductance			
11. Transformers			
12. Capacitance			
13. RLC Circuits			
14. Resonance			
B. Basic Wiring		C. Demonstrate Entry Level Skills for Residential Wiring	
1. Occupational intro- duction		D. Evaluation of Residential Wiring	
2. Tools			
3. Blueprints and specifications			

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
IV. INDUSTRIAL BLUEPRINTS AND/OR SCHEMATICS A. Industrial Symbols B. Industrial Layout C. Industrial Codes	20	A. Shop Activities Reading and Drawing Industrial Prints B. Review of Code	20
V. INDUSTRIAL WIRING DEVICES A. Identification of Devices 1. Conductors 2. Boxes 3. Raceways 4. Distribution panels 5. Transformers a. Single phase b. Three phase B. Procedures 1. Conductors a. Insulation b. Size c. Ampacity d. Derating e. Others	52	A. Calculation and Selection of Conductors	33

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
2. Boxes a. Types and sizes b. Mounting and hangers c. Maximum number of conductors calculations d. Strain relief		B. Calculations, Selection and Mounting of Boxes	
3. Raceways a. EMT-electrical metallic tubing b. IMC-intermediate metal conduit c. RMC-rigid metal conduit d. Flexible conduit e. PVC-polyvinyl chloride pipe f. Others		C. Selection and Installation of Raceways	
4. Distribution panels a. Size b. Type c. Mounting d. Overcurrent protection e. Industrial visits to view distribution panels		D. Field Trip to Industry	

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
1. DC motors a. Types (1) Series (2) Shunt (3) Compound b. Uses c. Ratings		A. DC Motor Demonstrations	
2. AC Motors a. Types (1) Split phase (2) Capacitive start (3) Capacitive run (4) Repulsion induction (5) Synchronous (6) Others b. Uses c. Ratings		B. AC Motor Demonstrations	
3. Universal motors		C. Universal Motor Demonstrations	
B. Power Generator Theory			
1. DC generators		D. DC Generator Demonstration	
a. Types (1) Series			

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
(2) Shunt (3) Compound b. Uses c. Ratings 2. Alternators a. Types b. Uses c. Ratings		E. Alternator Demonstration	

ADVANCED WIRING REFERENCES:

- I. Clidero, Robert K. and Sharpe, Kenneth H. Construction Wiring.
New York: Delmar Publishers, 1982.
- II. Johnson, Robert C. Electrical Wiring: Design and Construction.
New York: Prentice-Hall, Inc., 1971.
- III. Lenk, John D. Handbook of Simplified Electrical Wiring Design.
New York: Gregg/McGraw-Hill, 1979.

INTRODUCTION TO CONTROLS AND ELECTRONICS

One Semester

Introduction to Controls and Electronics.--This course is designed to introduce the student to basic industrial controls, basic electronics including solid state and digital devices. An introduction to microprocessors is also included. Basic electricity is the prerequisite for this course.

MAJOR DIVISIONS	Class Hours	Shop Hours
I. INTRODUCTION TO ELECTROMECHANICAL CONTROL SYSTEMS	30	0
II. SOLID STATE DEVICES AND POWER SUPPLIES	37	53
III. INTRODUCTION TO SOLID STATE CONTROLS	20	40
IV. INTRODUCTION TO DIGITAL ELECTRONICS	30	50
V. INTRODUCTION TO MICROPROCESSORS	<u>10</u>	<u>0</u>
	Total Class Hours 127	Total Shop Hours 143
Total Suggested Clock Hours <u>270</u>		

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
B. Power Supplies 1. Rectification principles 2. Filtering principles 3. Voltage dividers 4. Current dividers 5. Regulation 6. Voltage multipliers 7. Others		G. Build, Test, and Troubleshoot Various Power Supply Systems	
III. INTRODUCTION TO SOLID STATE CONTROLS A. Motor Speed Control 1. SCR 2. DIAC 3. TRIAC 4. Others B. Sensing Circuits 1. Temperature sensors 2. Liquid level sensors 3. Photo or light sensors 4. Sound sensors 5. Motion sensors 6. PH sensors	37	A. Demonstrate, Build, and Test Motor Speed Control B. Demonstrate, Build, and Test Sensing Circuits	53

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
7. Pressure sensors			
8. Others			
IV. INTRODUCTION TO DIGITAL ELECTRONICS	30		50
A. Integrated Circuits		A. Identify IC's	
1. Description			
2. Manufacturing process			
3. Packaging			
4. Installation procedures		B. Install and Remove IC's	
a. Handling			
b. Soldering			
5. Uses		C. Demonstrate Analog and Digital Circuit Applications	
a. Analog			
b. Digital			
6. Numbering			
a. Commercial			
b. Military			
7. Reference guides		D. Cross-reference IC's	
a. Commercial			
b. General purpose			
c. Others			

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
B. Binary Math 1. Base two 2. Counting in binary 3. Code conversion a. (BCD) binary coded decimal b. (HEX) hexa-decimal 4. Adding 5. Substraction a. Complement b. One's complement			
C. Logic Gates 1. Logic voltage levels a. High b. Low 2. Logic gates and truth tables a. Inverter b. And c. Or d. Nand e. Nor f. Xor		E. Use Logic Probes and Other Measuring Devices to Determine Logic Level F. Build and Test Logic Gates; Draw Truth Table	

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
g. Xnor h. Negation			
3. Logic circuit configuration			
a. (TTL) transistor-transistor logic b. Open collector c. Tristate			
D. Timing and Control			
1. Flip-flops		G. Demonstrate and Build Data and J-K Flip-Flops	
a. Data b. J-K			
2. Counters		H. Demonstrate, Build, and Troubleshoot Counters	
a. Divide by 10 b. Divide by 12 c. Divide by 16			
3. Clock circuits		I. Demonstrate, Build, and Troubleshoot Clock Circuits	
a. Monostable b. Bistable c. Astable d. Crystal control			
4. Registers		J. Demonstrate Serial and Parallel Registers	
a. Serial b. Parallel			

OUTLINE OF INSTRUCTION	CLASS HOURS	SHOP ACTIVITIES	SHOP HOURS
5. Codes a. (ASCII) American Standard Code for Information Interchange b. (BCD) Binary Coded Decimal			
V. INTRODUCTION TO MICRO-PROCESSORS A. Architecture B. Language 1. Binary 2. Machine 3. Basic 4. Others C. Memory 1. (ROM) Read Only Memory a. (PROM) Programmable Read Only Memory b. (EPROM) Erasable Programmable Read Only Memory 2. (RAM) Random Access Memory D. Applications of Micro-processors	10		0

INTRODUCTION TO CONTROLS AND ELECTRONICS REFERENCES:

- I. Alerich, Walter N. Electric Motor Control. 3rd. ed. New York: Delmar Publishers, Inc., 1983.
- II. Boyce, Jefferson C. Microprocessor and Microcomputer Basics. New York: Prentice-Hall, 1979.
- III. Hall, Douglas V. Microprocessors and Digital Systems. 2nd ed. New York: Gregg/McGraw-Hill, 1983.
- IV. Kershaw, John D. Digital Electronics: Logic and systems. Massachusetts: Duxbury Press, 1976.
- V. McIntyre, R. L. Electric Motor Control Fundamentals. 3rd ed. New York: Gregg/McGraw-Hill.
- VI. Rexford, Kenneth B. Electrical Control for Machines. 3rd ed. New York: Delmar Publishers, Inc., 1983.
- VII. Zbar, Paul B. Industrial Electronics: A Text-Lab Manual. New York: Gregg/McGraw-Hill, 1981.

EQUIPMENT LIST

ELECTRICITY/ELECTRONICS

EQUIPMENT LIST
ELECTRICITY-ELECTRONICS

Item No.	Quantity	Description
<u>STUDENT EQUIPMENT</u>		
1	10	Student Workbenches
2	22	Student Stools
3	10	Multimeters
4	10	Digital Multimeters
5	10	Power Supplies 0-50 v. 5-10 amps.
6	10	Audiofrequency Generators
7	5	Dual Trace Oscilloscopes
8	5	Single Trace Oscilloscopes
9	5	Z Meters
10	10	Logic Probes
11	10	Logic Analyzer Clips
12	10	Soldering Stations
13	10	Amprobes with Cases
14	1	Meger
15	10	Pliers, Longnose, 6"
16	10	Pliers, diagonal, 5"
17	10	Pliers, combination, 6"
18	10	Pliers, lineman, 9"
19	10	Rules, 6'
20	10	Tapes, 10'

EQUIPMENT LIST
ELECTRICITY-ELECTRONICS (Continued)

Item No.	Quantity	Description
21	10	Romex Stripers
22	10	Electricians Knives
23	10	Chalk Lines
24	10	Plumb Bobs
25	10	Wire Gages
26	10	Screwdrivers, 2" x 1/8"
27	10	Screwdrivers, 6" x 1/4"
28	10	Screwdrivers, 3" x 3/32"
29	10	Screwdrivers, Phillips #1
30	10	Screwdrivers, Phillips #2
31	10	Screwdrivers, Phillips #0
32	10	Nutdriver Sets, Hollow Shafts, 6/32", 7/32", 8/32", 9/32", 10/32", 11/32", 12/32", 14/32", 16/32", 18/32"
33	2	Pullropes 100'
34	10	Toolpouches with Belts
35	10	Toolboxes
36	20	Hard Hats
37	5	Face Shields
38	3	Handsaws
39	3	Braces

EQUIPMENT LIST
ELECTRICITY-ELECTRONICS (Continued)

Item No.	Quantity	Description
40	6	Sets of Ship Arger Bits
41	3	Expansion Bits
42	6	Keyhole Saws
43	1	Set of Hole Saws
44	2	Sets of Flatwood Bits 1/4" x 2"
45	10	3/4" Woodchisels
46	2	Sets Assorted Sizes of Wire Mess Cablepullers
47	5	Tinsnips, Straight
48	5	Tinsnips, Left
49	5	Tinsnips, Right
50	5	Squares, Combination
51	10	Wrenches, Adjustable 8"
52	10	Hammer, Ballpein, 16 oz.
53	10	Hammer, Ballpein, 8 oz.
54	10	Electricians Hammers
55	10	Punches, Set (Center, Pin, Prick)
56	10	Hacksaws, 12", Adjustable
57	10	File Sets, Mill (6", 8", 10", 12")
58	10	Swivel Screwdrivers
59	1	Set, Cold Chisels, Flat (13/32", 1/2", 3/4")

EQUIPMENT LIST
ELECTRICITY-ELECTRONICS (Continued)

Item No.	Quantity	Description
60	5	Vise, Machinist's, 4" Jaw, 6" Opening, Swivel Base
61	5	Drills, Electric, 3/8", Heavy Duty, Variable Speed, Reversible
62	2	Drills, Electric, 1/2"
63	1	Tap and Die Set, Electricians
64	1	Reamer, Hand, 1/8" Tip, 5 1/2" Long
65	3	Pipe Reamers
66	3	Twist Drills, Sets, 1/16" Through 1/2" x 32nds.
67	3	Wood Drill Bits, 3/4" x 2" Arger Type
68	1	Drill Press, Floor Type, Variable Speed
69	1	Grinder, Dual Shaft, 6", 1/2 hp. Motor with Brush
70	2	Lamps, Bench, with Magnifier
71	1	Wrenches, Sockets, Metric, 1/4" Drive Set
72	2	Moto-tool, with Attachments and Drill Bits #60 Through #80
73	10	IC Extractor/Insertion Sets
74	5	Manual Wire Wrap Tool Sets
75	1	Desoldering Station
76	10	Crimping Tools

EQUIPMENT LIST
ELECTRICITY-ELECTRONICS (Continued)

Item No.	Quantity	Description
77	5	Rechargeable Drills
78	3	Pipe and Tubing Cutters
79	1	Set of Conduit Crimpers 1/2", 3/4", 1"
80	3	Buchannan Splice Tools
81	10	Sets, Long Shank, Hex, Allen Wrenches
82	1	Impact Hammer
83	1	Skill Saw
84	1	Jigsaw
85	45	Safety Glasses with Cabinet
86	6	Fishtapes, 100'
87	1	Pipe vice with Stand
88	1	Manual Pipe Threader with Die 1/2"-2"
89	5	Chanel Locks
90	3	1/2", 3/4", 1" Offset (Hicker Benders with Handle)
91	1	Hydraulic Bender, 1/2", 3/4", 1"
92	3	Ninety Benders, 1/2", 3/4", 1"
93	1	Rigid or Mechanical Type Bender
94	1	Air Compressor
95	1	Knockout Punch Hydraulic

EQUIPMENT LIST
ELECTRICITY-ELECTRONICS (Continued)

Item No.	Quantity	Description
<u>TEACHER EQUIPMENT</u>		
96	1	Teacher Desk
97	1	Swivel Chair
98	2	File Cabinets, 4 Drawer
<u>TRAINING AIDS</u>		
99	1	Projector, Overhead
100	1	Projector, Filmstrip w/Auto Sound Advance
101	1	Projector, 16mm, with Frame Stopping
102	1	Projector, Slide
103	1	Screen, Projection
104	1	Tape Recorder, Cassette
105	1	Set, National Electric Code Manuals
106	1	Set, Digital Data Books
107	1	VTR System with Camera and Monitor
108	10	Digital Logic Trainers
109	10	Microprocessor Trainers
110	10	Basic Electricity Trainers
111	3	Motor Control Trainers
112	3	Motor Generator Trainer
113	5	Wiring Boards
114	5	Residential Wiring Mockups